

April - September 1962

Northeastern

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NORTHEASTERN FOREST EXPERIMENT STATION

Division of Watershed Management Research

Semi-annual Report

October 1962

GENERAL

In June we had a watershed research conference at Laconia on collection and compilation of streamflow records to compare our point-picking handicraft with recently developed machine procedures. Ron Hibbert came up from Coweeta to present their experience. Other visitors were Station statisticians, equipment salesmen, and watershed professors. A Station publication will give our conclusions: suffice it, we found some difficulty relating our effort to the Space Age.

In another general project, some time was spent in assembling information on the forest, soil, and climate for a forest atlas of the Northeast, pursuing the feeling that extension of our research results to ungaged areas away from the Fernow or Hubbard Brook demands something more than a hopeful guess. Towards that same end, Reinhart plans to impose Thornthwaite's procedures on Fernow data and check predicted water surplus and potential ET against measured values, and Bill Sopper at Penn State is analyzing USGS streamflow records in the Northeast for similarities and differences by physiographic regions.

The Hubbard Brook people soon plan to move out of their trailer into a new office building that overlooks one of the best views in the White Mountains. At Parsons, Watershed will share next year a new lab-office with Forest Management. These will shelter, we can hope, new ideas.

FERNOW EXPERIMENTAL FOREST

Publications, meetings, and conferences--in addition to routine record collection and compilation--accounted for a major part of our effort in this period.

In May we reviewed our watershed program with Lull. Plans are to start treatment of forested Watersheds 6 and 7 in 1963. Each watershed will be clearcut in two steps followed by application of silvicides. Tentative plans call for treatment of openland Watersheds 8 and 9, starting in 1965, to determine effects of reforestation on streamflow. A big job still remaining is the calibration analysis on these two watersheds. No major new studies are planned for the

next year. At the same conference, initial planning was undertaken on the new Parsons laboratory; Bob Pierce of Laconia helped out on this.

Following a conference at Laconia on method of compiling streamflow records, we looked into the basis and accuracy of the procedure we use for determining maximum permissible rise before making a break in the hydrograph (in conjunction with the point-picking method). The results of this study will be reproduced and distributed.

With publication of a paper in the Journal of Geophysical Research and a Station Paper (in press), the major results of the study of effects of forest practices on streamflow have been recorded. We are still studying the same records because we are sure there are many possibilities for extracting additional results of value.

Reinhart attended the annual meeting of the Soil Science Society of America at Cornell in August and presented a paper: Approximating soil-moisture storage in the experimental watershed using streamgaging records. He also attended the West Virginia Inter-Agency Forestry and Wildlife Conference in May and gave a talk, Hydrologic effects of forests on small watersheds.

--Ken Reinhart

HUBBARD BROOK EXPERIMENTAL FOREST

Stream-gaging Stations

The 6th and last in one group of gaged watersheds, all of which are contiguously nested in a compact area, was completed this summer. The 6 watersheds range in size from 29 to 105 acres, have a generally southeast aspect, and are quite uniform in cover, slope, soils, and geology. A further feature of these watersheds is that the soils are entirely glacial drift plastered on relatively smooth, unweathered, essentially deep-seepage free, granite and gneiss bedrock--perfect for studying large natural lysimeters. The gaging station at #6 is a combined one-foot-high 90° v-notch with a 7 x 8-foot basin, and a 2-foot-wide San Dimas flume. Total construction cost was \$2,000.

The next set of watersheds to be gaged (construction is anticipated in 1963) will be on north-facing slopes, also contiguous, but larger in size--about 170 acres. Spur roads are being built to the gaging sites now.

Our combined v-notch weir and San Dimas flume has so far performed equally as well, if not better, than the single large basin

and v-notch. The smaller basin can be covered in winter, and with a floating gas heater keep the area around the blade free of ice. Some icing developed in the flume, but we feel this can be licked by also enclosing the flume and installing a small heater.

--Bob Pierce

Microclimatic Study

Microclimatic studies in a northern hardwood forest got under way this summer at Hubbard Brook. A 72-foot steel tower was erected of lightweight (30 lb./section) scaffolding leased from a local firm. The 4 x 7-foot rectangular shape with built-in ladder facilitated climbing as well as mounting and reading instruments. The light-weight sections were easily carried to the site, and set up by two men. Screw jacks on each leg were used to level it on uneven ground. The tower was guyed to the ground on the four corners at six levels with 1/4-inch guy wire. A favorable feature of the tower is that it can be erected at almost any point, and made to pass through the canopy without cutting or damaging the tree branches.

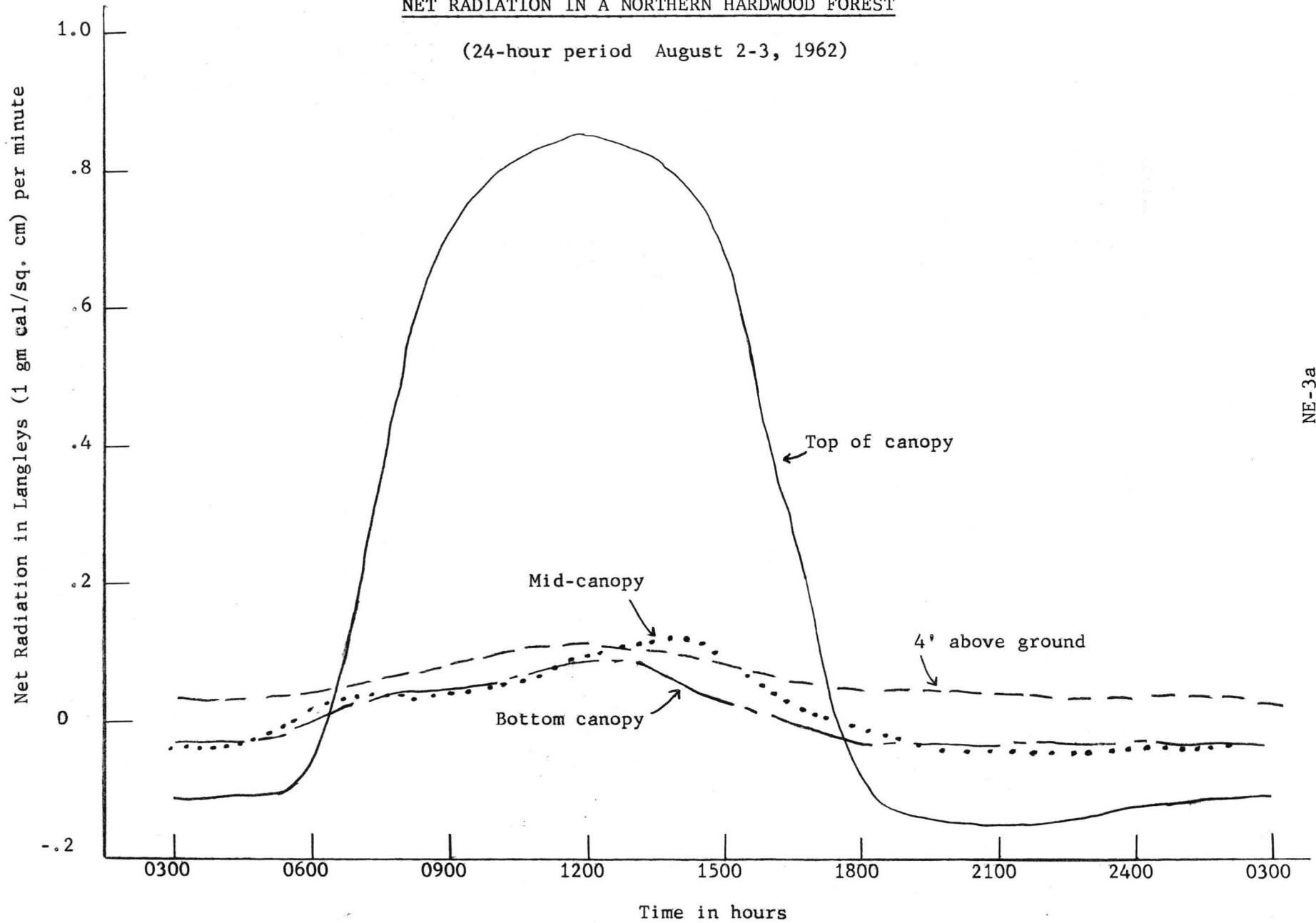
Measurements of solar radiation, air temperature, and relative evaporation were taken at 30-minute intervals for 24-hour periods at five levels in the forest canopy. Approximately 10 days were sampled in August and September. Solar radiation was measured with the "Poorman's" net radiometer sensing heads wired to Goodell's Pinball counters. Air temperature was measured with shielded thermocouples, and relative evaporation was taken with Bellani black plate atmometers. The carload of data taken for these few short runs will be analyzed this winter. A few points of interest have come to light in a cursory examination. Figure 1 illustrates the wide difference in net radiation above the hardwood canopy with radiation at points 4 feet above the ground, bottom of the canopy, and mid-canopy.

Air temperature appears to be the same at all levels below the top of the canopy between midnight and one hour prior to sunrise on cloudless nights.

The tower afforded the opportunity to dispel a common belief--that the top of the canopy is a fairly uniform surface. It is not. Tremendous variations exist in total tree height, level of individual crowns, mosaic arrangement of adjacent branches, orientation of leaf surfaces, and canopy microtopography. It seems likely that such canopy microrelief would play an extremely important role in the transpiration of forest stands. Perhaps this is one area our

NET RADIATION IN A NORTHERN HARDWOOD FOREST

(24-hour period August 2-3, 1962)



research has neglected.

--Ray Leonard

Miscellaneous

Progress is being made on our new field quarters at Hubbard Brook. The building, a 2-story, 30 x 60-foot structure should be ready for occupancy by Christmas.

George Hart returned for a short-lived "summer vacation" from the University of Michigan, but all too soon had to pack his bags and leave for another year at the books. This school year should wind up his residence requirements for a PhD--his major is forest hydrology.

NEW LISBON

Rainfall was seriously deficient this past growing season: the Newark and Baltimore watersheds suffered a drought throughout the whole period and the Penn State area received even less rainfall. Many of the experimental watersheds stopped flowing and others recorded the lowest flows of record.

Water-Contamination Study

At many of the municipal watersheds in the Northeast stream-bank and reservoir-shore vegetation is controlled by chemicals. This has bothered water-supply chemists, who are fearful of contamination. The phenoxy herbicides such as 2,4-D and 2,4,5,-T have been particularly disfavored, because chlorophenol imparts a medicinal taste to drinking water. The literature contains a large amount of data on the taste and odor thresholds of the chlorophenols, but the contaminating effects of the phenoxy herbicides are not known. Chemists have contended that the breakdown products of the phenoxy herbicides were the various chlorophenols, but a recent study showed that bacterial action in soils resulted in their decomposition to carbon dioxide, inorganic chlorides, and water.

As foresters generally prefer phenoxy herbicides a study was devised to determine their possible contaminating effects.

Two small streams were chosen, on the Newark watershed and on Penn State's Stone Valley Forest, and the riparian vegetation was sprayed, using a mistblower. On one stream 2,4,5-T in oil-water emulsion was used, while the vegetation along the other stream received an application of an emulsifiable acid of 2,4,5-T (no oil carrier in the concentrate or in the diluting material). About 1,000 lineal feet of stream was treated at each replication, with about 20 feet of application on each side. Water samples were

taken immediately before and after spraying and periodically thereafter.

Testing the samples for contamination was the most difficult part of the study. Chemical procedures were available, but not for the very low concentrations around the taste and odor threshold. Of course very large samples could have been taken, to be concentrated later for chemical analysis; but the large samples required--about 10 gallons--would have made the testing very expensive and the transportation problem insurmountable.

The alternative method to chemical analysis was the use of taste and odor panels. Robert P. Baker, a chemist at the Franklin Institute in Philadelphia, had recently made a comprehensive study on taste and odor testing and had concluded that the human nose was the best apparatus for detecting undesirable odors.

Of the two panels set up, one at Penn State and the other at New Lisbon, the former delivered the more sensitive and consistent results. To date we have learned that there was a small amount of contamination immediately after spraying. A slight amount was found after the first large rain. No contamination was ever found in a downstream sample, in which dilution had occurred. There is some evidence that chlorination oxidizes and eliminates the contaminating substances rather than accentuating the odor of it. The herbicide seems to decompose in raw water (which always has a certain organic content), so that reservoir storage would have a purifying effect on contamination if it occurred.

Bill Sopper of Penn State and Roy Johnson of Amchem, Inc., are cooperators in this study.

Other Field Work

As noted in recent semi-annual reports, the concrete weir boxes at our cooperative projects are beginning to leak. Leaks developed in two of the three concrete weirs at the Newark watershed. One was sealed with bentonite but the same treatment was unsuccessful at the other weir. The latter was lined with vinyl plastic in August.

One of the two concrete weirs at the Baltimore watershed was lined last summer. The other one is now leaking and will be lined next month.

The wooden flume installed last summer at Penn State was lined with vinyl plastic. This appears to have been a mistake, as the plastic shrinks in cool temperatures and pulls away from the wood in the corners. The stretched plastic with no firm backing was

vulnerable to punctures last winter and needed repairs this summer. Even after repair, the shrinking continued and the lining will probably be punctured again this winter. Instead of the plastic liner, an asphalt membrane should have been applied to those areas where leakage would occur--primarily the corners where the walls meet the floor of the flume and the approach box.

Soil Moisture and Bulk Density Variation

Some results from the soil-moisture study at the Lebanon Experimental Forest were presented at the annual meeting of the Soil Science Society of America at Cornell in a paper by Irv Reigner and John Phillips, Variations in bulk density and moisture content within and between closely-spaced plots in Lakeland and Lakehurst sands.

--Irv Reigner

SYRACUSE

Preliminary analyses of 50-years of streamflow record for a five hundred square-mile drainage area in the Adirondacks indicates that there has been a definite decrease in total streamflow during the dormant season. This occurred over a period when the State of New York was acquiring approximately three-fourths of the land in the watershed. Exclusion of fire and cutting on this land is inferred to have resulted in increased forest density and some change in composition. A detailed study of the vegetation history is being made.

Growing season decreases in streamflow were insignificant, but use of an estimate of average watershed precipitation, instead of the single station precipitation record used as an index, may remove some of the variation in the multiple regression which is obscuring a significant effect.

--Art Eschner

PUBLICATIONS

Effect on streamflow of four different forest practices in the Allegheny Mountains. K. G. Reinhart and A. R. Eschner. Jour. Geophys. Research 67: 2433-2445.

Manuscripts Submitted

Leaf fall, humus depth, and soil frost in a northern hardwood forest. George Hart, Raymond Leonard, and Robert Pierce.

Forest influences by questionnaire. Howard W. Lull.

Approximating soil-moisture storage in the experimental watershed using streamgaging records. K. G. Reinhart.

Some observations on precipitation measurements on forested experimental watersheds. Raymond Leonard and Kenneth G. Reinhart.

Proceedings of the watershed management research conference on collection and compilation of streamflow records. Watershed research staff.

Some relationships among air, snow, and soil temperatures and soil frost. George Hart and Howard W. Lull.